DOGANOVSKIY, S.A.; FEL'DBAUM, A.A. (Moskva)

Using an electronic analog computer in investigating compensations for thickness variations of rolled strips. Avtom.i telem. 20 no.2:192-205 F '59. (MIRA 12:3)

(Rolling (Metalwork)

GAVRILOVA, M.A., doktor tekhn.nauk; ARTOBOLEVSKIY, S.I., doktor tekhn. nauk; BERSHTEYN, S.I., kand. tekhn. nauk; BOLGAKOV, A.A., kand. kand. tekhn. nauk; LERNER, A.Ya., doktor tekhn. nauk; MEYEROV, M.V., doktor tekhn. nauk ; SUKHOV, N.K., doktor tekhn. nauk; FEL'DBAUM, A.A., doktor tekhn. nauk; FILIPPOVICH, B.I., doktor ~~tekhn. nauk;~~ KHAMOY, A.V., doktor tekhn. nauk; SHORYGIN, A.B., doktor tekhn. nauk

[Terminology on the basic concepts of automatic control] Terminologiia osnovnykh poniatii avtomatiki; doklad. Moskva, 1960. 31 p. (International Federation of Automatic Control, ost Internationa Congress, Moscow, 1960. Doklady, no.232) (MIRA 14:8)

1. Natsional'nyy komitet po avtomaticheskomu upravleniyu. Nauchno-tekhnicheskiy komitet terminologii. 2. Nauchno-tekhnicheskiy komitet terminologii Natsional'nogo komiteta SSSR po avtomaticheskomu upravleniyu (for all).
(Automatic control—Terminology)

9-2

FEL'DBAUM, A.A.

report to be presented at the 1st Intl Congress of the Intl Federation of Automatic Control, 25 Jun-5 Jul 1960, Moscow, USSR.

BYKHOVSKIY, M. L. - "Ultra stability in electronic calculating devices in the solution of nonlinear equations in indefinite form"
CHELYUSTKIN, A. B. - "Use of calculating devices in systems for the automatic control of rolling mills"
CHICHINADZE, V. K. - "Concerning some problems of the organization of self-adjusting and self-teaching systems of automatic control, based on principles of random search"
DAVYDOV, E. I. - "Development of automatic control systems for boiler units"
DUDNIKOV, Ye. G. - "Determination of optimum adjustments of industrial automatic regulation systems according to initial data obtained from experience"
DUB'YE, A. I., and ROZENVASSER, E. N. - "Methods of organizing Lyapunov functions in the theory of nonlinear regulating systems"
DROZHZHIN, N. N. - "Balanced regulation and inter-communications of a multi-motor electric drive and technology in continuous rolling mills"
FEL'DBAUM, A. A. - "Problems of statistical theory of automatic optimization systems"
FETUIN, V. I. - "Automation of a reversible cold rolling mill for nonferrous metals"
FILIPPOV, A. F. - "Application of the theory of differential equations with a discontinuous right side to nonlinear problems of automatic regulation"
GAVRILOV, M.A. - "Structural surplus and operational reliability of relay devices"
GANKIN, M. Z. - "Automation of irrigation systems"
GERCHENBERG, G. R., KASHTELYAN, V. E., KOSTENKO, M. P., NEYMAN, L. R., and SIRIY, I. S. - "Power regulation of disturbance and problems of the stability of electric power systems"
GINZBURG, S. A. - "Logical method of synthesis of functional converters"
IL'IN, V. A. - "Methods of transmission of information and the structure of telemechanical systems for dispersed structures"
INOSOV, V. L., and LUTSKIY (fnu) - "The code-impulse system of telemeasurement for dispatched operations of trunk-line gas pipe lines"
IVAKHNENKO, A.G. - "Concerning the application of the theory of combined regulation systems for cybernetic adaptation systems"
KARANDEYEV, K. B., and SHTAMBERGER, G. A. - "A quasi-equilibrated bridge as an element in a system of automatic control"
KAZAKEVICH, V. V. - "Concerning the process of extra regulation of inert objects in the presence of disturbance"
KAZAKOV, I. E. - "Some problems of the theory of statistical linearization and its application"
KILIN, F. M. - "Some problems of the theory of impulse systems with time selectors"
KOBRINSKIY, A. E., BOLKHOVITIN, S. V., VOSKRESENSKIY, L.M., IOFFE, D. M., POLYAN, E. P., POPOV, B. P., SLAVUTSKIY, Ya. L., SYSIN, A. Ya., and YAKOBSON, Ya. S. - "The problem of bioelectric control"
KOLOMIYETS, B.T. - "New types of photo resistances and their field of use"
KOROBKO, M.I., MIKHYUKOV, B. G., and SHIMILOV, K. A. - "System of automatic control and regulation of blast distribution in the tuyeres of blast furnace"
KOROBOCHKIN, B. L. - "Investigation of the dynamics of the hydraulic duct of a copying lathe"
KRASOVSKIY, A. A. - "Dynamics of continuous systems of automatic regulation with extra self-adjustment of corrective devices"
KRASOVSKIY, N. N. - "Concerning the selection of parameters of optimum stability systems"
KUKHTENKO, A. I. - "The dynamics of devices imitating living organisms"
KULEBAKIN, V. S. - "The invariant theory of automatic regulation and control systems"
LANIN, I. D. - "Pneumatic calculating devices as a means of insuring the reliability of complex automation systems"
LAZAREV, V. and PARKHOMENKO, P.P. - "Mechanization of processes of analysis and synthesis of the structure of relay devices"

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1.7000

25538

S/123/61/000/011/023/034
A004/A101

AUTHOR: Fel'dbaum, A. A.

TITLE: The effect of random factors on the automatic scan process

PERIODICAL: Referativnyy zhurnal, Mashinostroyeniye, no. 11, 1961, 4-5, abstract 11D30 (V sb. "Teoriya i primeneniye diskretn. avtomat. sistem". Moscow, AN SSSR, 1960, 464-479)

TEXT: The author analyzes two types of discrete optimalizing systems: 1) Systems with extrapolation in which the operating motion, after the trial step, is effected which leads the system immediately to the extremum; 2) step-by-step systems in which every trial step is accompanied by the operating displacement of a definite magnitude in the necessary direction. It is assumed that the object characteristic has the form $y = /x/$, while disturbance z consists of a quantity which has a random distribution but does not change during the scan time, and a discrete random process with a mean value equal to zero. If there are random disturbances it is expedient, for a more accurate selection of the right direction of displacement, to increase the number of trial steps and average their results. The author derives expressions determining the optimum number of

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A004/A101

The effect of random factors ...

trial steps n, at which the mathematical expectation of the total scan time represents a minimum. It is shown that: a) for systems with extrapolation $n = 1$; b) for step-by-step systems with alternating trial and operating steps $n = 1$ at $\vartheta < 0.88$, $n = 2$ at $\vartheta < 0.88$; $n > 2$ at $\vartheta < 0.2$ (ϑ- signal-to-noise ratio); c) for step-by-step systems in which the preceding operating step serves as trial step for the following, at a normal distribution of disturbances $n = 1$ at $\vartheta > 0.2$, while with a uniform distribution of disturbances $n = 1$ at $\vartheta > 0.75$ and $n = 2$ at $0.2 < \vartheta < 0.75$. For the above optimalizing systems the author presents expressions determining the mean scan time as a probability function of the spurious step in the result of n trial steps. There are 7 figures and 17 references.

I. Pyshkin

[Abstracter's note: Complete translation]

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FEL'dbAUM, A.A.

S/024/60/000/04/006/013
E140/E463 82210

16,6800

AUTHOR: Fel'dbaum, A.A. (Moscow)

TITLE: Automatic Synthesis of Processes, Algorithms and Systems

PERIODICAL: Izvestiya Akademii nauk SSSR, Otdeleniye tekhnicheskikh nauk, Energetika i avtomatika, 1960, No.4, pp.109-120

TEXT: This paper was presented at the Scientific Session of the All-Union Society for Science and Technology imeni A.S.Popov, May 1960.

The paper gives a survey of work in progress at the Institute of Automation and Telemechanics of the USSR Academy of Sciences on automatic synthesis of optimal systems. The principal members of the group are L.N.Fitsner, R.I.Stakhovskiy and the author. The basic types of automatic systems are first described: uniformly optimal systems, statistically optimal systems and minimaximally optimal systems. In the first, the process is optimal for arbitrary perturbations within a given class; in the second, a statistical quality criterion must take on an extremal value, while a number of secondary conditions are imposed (e.g. limitations in

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Automatic Synthesis of Processes, Algorithms and Systems

maximum value of some parameter); in the third, the poorest result obtained is better than the poorest result in any other system. In automatic synthesis two cases are possible: one where a definite algorithm exists, which is not considered here, and one where only an incomplete algorithm is present or none at all. In this case synthesis reduces to a process of searching for possible solutions. Starting at random, an arbitrary initial solution is evaluated according to the given criterion. Further solutions are then constructed on the basis of gradient or steepest descent methods. The machine on which the solution is calculated is an "automatic optimizer". This machine may be used to find the solution in the form of a defined structure which may be physically realized or it may itself be built into a complicated system. The automatic optimizer consists of the following parts: a model of the fixed part of the system, a model of the part of the system to be optimized, with structure and parameters under the control of the optimizer, the optimizer proper, auxiliary equipment (computers, memory, clock signals etc.). The system is thus hybrid, part being analogue, part digital (rather, logical).

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Automatic Synthesis of Processes, Algorithms and Systems

Two systems have been constructed, one fully electronic and one relay-electronic, differing in speed and accuracy. Three examples of applications are mentioned: automatic approximation of functional dependencies, d.c. servomechanisms and experimental determination of a simple non-linear control algorithm. It is claimed that an automatic optimizer for problems with local extremes has been developed, capable of finding the absolute extreme value. There are 8 figures and 8 Soviet references.

SUBMITTED: April 19, 1960

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85317

16.9500 (1031, 1132, 1344) S/142/60/003/004/001/013
E192/E382

AUTHOR: Fel'dbaum, A.A.

TITLE: New Principles of Automatic Control, Part II

PERIODICAL: Izvestiya vysshikh uchebnykh zavedeniy, Radiotekhnika, 1960, Vol. 3, No. 4, pp. 419 - 430

TEXT: The self-adjusting systems or automatic search systems are the most complex types of automatic control. In the first part of this paper it was shown that in the process of automatic search, numerous test moves (experiments) are carried out and their results are analysed. On the basis of these results a suitable operation is performed on the controlled object. The automatic search is a new process in engineering, but it is well known in nature and the natural selection process is nothing else but an automatic search process. In the following only those self-adjusting systems which automatically find theoptimum conditions are considered. These are the so-called automatic optimizers and they form one of the most important classes of self-adjusting systems. The problem in automatic optimization consists of automatic determination of a maximum or a minimum of a certain quantity;

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usually, some additional conditions should be met. The simplest example of an automatic optimizer is illustrated in Fig. 1. This device should determine such a value for the input quantity x of an object O that its output quantity y is a minimum; the problem is analogous if it is necessary to find the maximum. The system of Fig. 1 is the so-called extremum system with one variable. The operation of the system is as follows: for a value $x = x_1$ an output $y = y_1$ is obtained. A test step Δx is then performed towards increasing values of x, so that $x = x_2$ and the output is $y = y_2$. If the increment $\Delta y = y_2 - y_1$ is negative, the step was taken in the right direction and the system moves in the same direction. If on the other hand Δy is positive, the motion of the system should be in the opposite direction. In this manner it is possible to approach the optimum conditions for the object. In general, an optimizing system is more complex than the above example and it should minimize the function of

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many variables x_y ... x_n :

$$Q(x_1, \ldots, x_n) = \min \qquad (1)$$

and it should fulfil the conditions that a set of functions H_j should not exceed the prescribed limits, such as, for instance, as expressed by:

$$H_j(x_1, \ldots, x_n) \leqslant 0 \qquad (2).$$

The structural schematic of an automatic optimizing system is shown in Fig. 2. Here, the input quantities $x_1, \ldots, x_n$ of the object O form the output quantities of the automatic optimizer AO . Subsequently, the quantities $Q, H_1, \ldots, H_m$ which are measured at the output of the object O are applied to the input of the optimizer AO . Automatically, it adjusts the variable x_i in such a way as to obtain the minimum value

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of Q under the conditions that H_j should be less than zero. Automatic optimization can be effected by various means. One of these is known as the random search. This is a comparatively slow process. There exist much faster search methods such as the method of rapid descent and the method of gradient. These methods can be combined in an automatic optimizer in such a way that at large distances from the minimum the search is effected by the rapid descent method, while at short distances the gradient method is employed. The principle of such an optimizer is explained by means of an example with two independent variables (see Fig. 3). Various types of automatic optimizers are possible; thus, for example, by means of an automatic optimizer it is possible to carry out automatic synthesis of an optimum control circuit based on an electronic analogue. This is shown in Fig. 5, where MO is the analogue of the object and MY is the analogue of the control portion of the system. The analogue of the control system is constructed in such a way that it can change under

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the influence of the control parameters $x_1, \ldots, x_m$. If the number of these parameters is sufficiently large, it is possible to change the parameters, characteristics and even the structural circuit of the system. The analogue MO of the object and the analogue MY are connected together so as to form a closed system. The output of MO is also applied to the equipment K (see Fig. 5) which determines the optimum criterion for Q. The system of Fig. 5 performs direct optimization, that is the automatic selection of the most suitable circuit. A type of automatic optimizer is shown in Fig. 6. Here, the optimizer AO performs search tests on an analogue MC of a system O, the search being carried out very rapidly. After determining the optimum effect U, the control part transmits this through the equipment Π to the input of the object or the system O. In this way the search can be carried out with the required speed and the object is not subjected to tests which can influence its operation. A more complex, but more satisfactory system is shown in Fig. 7, where the analogue MC is compared with the characteristics

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New Principles of Automatic Control. Part II

of the actual system and is automatically corrected by the optimizer AO . The analogue is thus constantly "in touch" with the object, even if the characteristics of the latter undergo changes. The above systems of automatic search must evaluate rapidly a large number of parameter values and a large number of tests. Consequently, the computing device employed in the system should operate at high speeds; furthermore, a large memory is often required. During recent years some machines have been constructed which are capable of carrying out a complex type of search. An example of this is the Ashby homeostat (Ref. 5). The Mackay equipment (Ref.6) is a further development of this device. Another example of an automatic random search system is the Universal Digital Computer, type IBM-704. This can be programmed in such a way that it gives a heuristic proof of the theorems in the Euclidean geometry. This machine is an induction-type automaton and it does not always lead to the solution of the problem.

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New Principles of Automatic Control. Part II

There are 11 figures and 10 references: 5 English and 5 Soviet, 2 of which are translated from English.

ASSOCIATION: Kafedra avtomatiki i telemekhaniki Moskovskogo ordena Lenina energeticheskogo instituta (Chair of Automatics and Telemechanics of the Moscow "Order of Lenin" Power Institute)

SUBMITTED: February 15, 1960

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16.9500

SOV/103-21-2-2/14

AUTHOR: Fel'dbaum, A. A.

TITLE: Statistical Theory of Gradient Systems of Automatic Optimization With a Quadratic Characteristic of the Object

PERIODICAL: Avtomatika i telemekhanika, 1960, Vol 21, Nr 2, pp 167-179 (USSR)

ABSTRACT: The problem of automatic optimization consists in automatic search and maintenance of a certain minimum magnitude y. This magnitude is a function of many variables, u_1

$$y = y(u_1, u_2, \ldots, u_m). \quad (1)$$

Random noises may delay the automatic search process and may introduce an error in the determined minimum. The duration of the transient search process and the

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Statistical Theory of Gradient Systems of Automatic Optimization With a Quadratic Characteristic of the Object

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error in the steady-state operation are the basic magnitudes characterizing the automatic process. The paper considers systems of the discrete type, i.e., systems in which during one cycle a series of test movements is performed. Then, based on the analysis of the test results, an operation movement is made. During the following cycle there is again a series of tests followed by an operation step, etc. An example of an automatic system of optimization is shown on Fig. 1. Here, y is the controlling part. The magnitude y, which must be minimized, appears at the output of part F_o of the object. In the part F, the error z is added to y. At the input of the object the controlling magnitudes u_i are combined with the random noise z_{oi}. The resulting variables

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$$x_i = u_i + z_{oi} \qquad (2)$$

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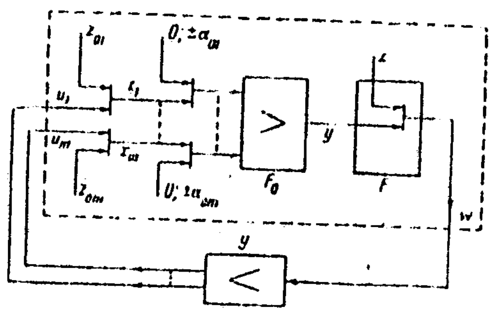

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Fig. 1.

are applied to the input of F_o. When the i-th variable is tested, an additional magnitude $+ a_{oi}$ is added to x_i during the first test interval, and $- a_{oi}$ during the second interval. Thus, each test consists of two intervals. When there are m variables, the entire cycle is composed of 2m intervals. Within the cycle, the first and the second interval of the i-th pair are numbered j and j + 1, respectively. The input noise may be expressed as $z_{oi} = \gamma_i n$, where n = 0,1,2..., is a discrete time, or the number of cycles, and γ_i is a random magnitude. The increments of the random noise z are assumed to be independent random magnitudes of distribution $\psi(v)$, the average value equal zero and the finite variance equal σ^2. The mathematical analysis of the automatic optimization process is based on the following expression for the relationship between y and the input magnitudes:

$$y = f(x_1, \ldots, x_m) = \sum_{i,k=1}^{m} b_{ik} x_i x_k, \qquad (4)$$

where $b_{ik} = b_{ki}$. It is assumed that the quadratic form of (4) is definitely positive. Then y has only one minimum at the origin of coordinates. The gradient method consists in a series of tests by which the direction of the gradient of y is determined. Then an operational step in this direction is made. The following vectors are introduced: (1) the vector x with coordinates x_i in an m-dimensional space Ω_x, whereby $x_i = x_{i,\,n+1}$; (2) the vector ζ with the coordinates ζ_i in the space $\Omega_\zeta = \Omega_x$, whereby $\zeta_i = x_{i,n}$; and (3) the vector γ with the coordinates γ_i. The above subscript n indicates the cycle in which the measurements were made. It is stated that the sequence x_n represents a Markov random process, since the probability distribution of x_{n+1} depends on the value of x_n. The convergence of the automatic search process is first analyzed under the assumptions that: (1) γ_i are fixed values; and (2) that there are no random noises. It is shown that under these assumptions it may be written

$$\mathbf{x} = A\xi + \mathbf{B}, \qquad (14)$$

Here A is the matrix with elements A_{ij}, and B is a vector with coordinates $\gamma_i + B_i$. Thereby A_{ij} and B_i are defined as

$$A_{ij} = \delta_{ij} + \frac{a_i}{m} \sum_{\substack{k=1 \\ k \neq i}}^{m} b_{kj} \gamma_k + a_i b_{ji} \left(\frac{\gamma_i}{m} - 4\alpha_{0i} \right),$$

$$B_i = \frac{4i-3}{2m} a_i \left\{ \frac{1}{2m} \sum_{\substack{j,k=1 \\ j,k \neq i}}^{m} b_{jk} \gamma_j \gamma_k + \left(\frac{\gamma_i}{m} - 2\alpha_{0i} \right) \sum_{\substack{j=1 \\ j \neq i}}^{m} b_{ji} \gamma_j + b_{ii} \gamma_i \left(\frac{\gamma_i}{2m} - 2\alpha_{0i} \right) \right\}. \qquad (13)$$

Here δ_{ij} is the Kronecker symbol. It equals unity or zero when $i = j$ or $i \neq j$, respectively. The necessary and sufficient condition for the convergence of the search process is given as

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$$|\lambda_k| < 1, \quad (19)$$

where λ_k $(k = 1,\ldots,m)$ are the roots of the characteristic equation $A - E\lambda = 0$ of matrix A. Here E is the unit matrix. The inequalities (19) correspond to the Routh-Hurwitz stability conditions. Assuming the convergence conditions to be satisfied, and reintroducing the random noises, an expression is derived for the probability $\varphi(\zeta, x)$ of the transition from the point $\xi = \{x_{1,n}; x_{2,n}; \ldots; x_{m,n}\}$ to the interval $x_i \leqslant x_{i,n+1} \leqslant x_i + dx_i$ $(i = 1,\ldots,m)$.

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$$\psi(\xi, x) = \prod_{i=1}^{m} \frac{\psi(r_i)}{a_i} = \prod_{i=1}^{m} \frac{1}{a_i} \psi\left\{\frac{1}{a_i}\left[\gamma_i - x_i + \sum_{j=1}^{m} A_{ij}\xi_j + B_i\right]\right\}. \qquad (24)$$

An expression is given for the mathematical expectation $M[y_n]$ of the random magnitude y_n, which is the average arithmetical value for the n-th cycle. A lengthy mathematical reasoning shows that the inequalities (19) assure the convergence of sequence $M[y_n]$ also in the presence of random noises v_i. The mathematical expectation η of the magnitude y at steady-state conditions is

$$\eta = \lim_{n\to\infty} M[y_n]. \qquad (42)$$

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$$J_j = (\gamma_j + B_j) + \sum_{\nu=1}^{m} A_{j\nu} J_\nu \qquad (j = 1, \ldots, m). \qquad (44)$$

It follows from Eqs. (43), (44), and (45) that the error is defined only by the variance σ^2 of the noise, and does not depend on the form of function $\psi(v)$. This property is a result of the quadratic characteristic of the object under steady-state working conditions: the mathematical expectation of deviation from y minimum is a measure for the error. In the case under consideration, $y_{min} = 0$. It is stated that the mathematical expectation may be considered also as a measure of duration of the transition process. When the vector γ is not fixed, an average magnitude η_{av} may be found from the expression

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$$\eta_{1av} = \int_{\Omega_\gamma} \eta W(\gamma)\, d\Omega_\gamma. \qquad (46)$$

where W(γ) is the probability distribution of γ and $d\Omega_\gamma = d_\gamma, \ldots, d\gamma_m$. However, for computation purposes it is convenient to use the expression (45) into which the expected maximum values of γ_1 are substituted. Two examples show how the above considerations are applied to the simplest system (m = 1) and to a system with two variables (m = 2). There are 5 figures; and 6 Soviet references.

SUBMITTED: June 12, 1959

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86245

S/103/60/021/011/001/014
B019/B067

16.9500 (1031,1132,1222)

AUTHOR: Fel'dbaum, A. A. (Moscow)

TITLE: Theory of Dual Control. II

PERIODICAL: Avtomatika i telemekhanika, 1960, Vol. 21, No. 11, pp. 1453 - 1464

TEXT: A general survey is given of the most important formulas and the determination of the optimum control algorithm for open, closed, and nonlinear systems with dual control. The first two chapters deal with the formulas for open systems. Function Γ_s is defined which describes the algorithm of the control part of an open system and represents the probability density of the parameters of the system. The expression for the general risk R is deduced where Γ_s must be determined such that R is a minimum. In determining the optimum strategy of open systems it is shown that Γ_s can be represented by a regular function. Similar considerations are made for closed circuits. An expression is again derived

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APPROVED FOR RELEASE: Monday, July 31, 2000 CIA-RDP86-00513R000412820(

Theory of Dual Control. II

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for the risk R. In determining the optimum strategy of the system it is again shown that Γ_s can be represented as a regular function. There are 3 figures and 1 Soviet reference.

SUBMITTED: March 23, 1960

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FEL'DBAUM, A.A. (Moskva)

Theory of dual control. Part 1. Avtom. i telem. 21 no.9:1240-1249 S '60. (MIRA 13:10)

(Information theory)

FEL'DBAUM, A. A. (Doctor of Technical Sciences)

"The Role of Analogies in Cybernetics."

Filosofskiye voprosy kibernetiki (Philosophical Problems of Cybernetics), Publishing House of Socio-Economic Literature, Moscow, 1961 392 p.

27655
S/024/61/000/004/013/025
E140/E135

16.8000 (1121, 1329, 3002)

AUTHOR: Fel'dbaum, A.A.

TITLE: On the accumulation of information in closed-loop automatic control systems

PERIODICAL: Izvestiya Akademii nauk SSSR, Otdeleniye tekhnicheskikh nauk, Energetika i avtomatika, 1961, No.4, pp.107-119

TEXT: Two problems must be solved in optimizing automatic control systems - determination of the characteristics and state of the object, and decision as to the control action required. Systems fall into three classes in this respect: systems with full information on the controlled object; systems with incomplete information and with "passive" accumulation of information on the object; systems with incomplete information and with "active" accumulation of information on the controlled object, also called "dual control". In this third class the control strategy is such as to obtain information more rapidly and to better effect. It is this class of system which is considered here. The work is a continuation of the author's previous work (Ref.5: Teoriya dual'nogo upravleniya "The Theory of Dual Control";

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I) Avtomatika i Telemekhanika, Vol.21, No.9, 1960; II) Ibid, No.11, 1960; III) Ibid, No.1, 1961; IV) Ibid, No.2, 1961). The present study takes into account the effects of noise which were neglected in the previous papers. The basic system is that of Fig.4, in which B is the object, subject to random perturbations z; G is the channel, subject to random noise q; over which the control action u is transmitted. Information on the object state x is also disturbed by noise h in the channel H, to give y, the signal applied to the controller A. The control programme x^* is also disturbed by the noise h^* in the channel H^*, giving the input y^* to the controller. In this system the action u tests the object and the result of these tests, y, is analysed in A. The analysis is conducted under the following assumptions: all quantities will be considered only at a fixed number of discrete instants; the perturbations are sequences of independent random quantities with constant densities, where the a priori probability densities of the object and signal noises are given; the object is inertialess (without memory); the laws of combination of noise and signal in channels H^*, H and G are known and constant, and these channels are without memory; the perturbations and their
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On the accumulation of information... S/024/61/000/004/013/025
E140/E135

parameters are mutually independent; the controller does have memory and the algorithm of this element is random. The derivation is similar to that in one of the earlier papers (Ref.5, IV). It is based on a definition of optimum in which the mean risk (the mathematical expectation of the loss due to the search process) is minimum. A seeming paradox is that while the object is assumed inertialess the risk at time s depends on the entire strategy from $t = 0$ to $t = s$. The physical reason for this is that the risk depends on the search strategy. Thus the risk is composed of two components, one due to the present action, one due to the learning process, and it is the total risk which has to be minimised. The derivation proceeds backwards from the last interval of time. It is found that despite the assumption of a random algorithm for the controller, the optimal strategy is regular and, since it depends only on past values of u, y and y^*, is physically realisable. A simple example concludes the exposition. There are 5 figures and 7 references: 6 Soviet (two of them translations into Russian from works of non-Soviet authors) and 1 English. The English language reference reads as follows:

Card 3/4

27655
On the accumulation of information... S/024/61/000/004/013/025
E140/E135

Ref.4: D. Middleton. An Introduction to Statistical Communication Theory, 1960.

SUBMITTED: March 4, 1961

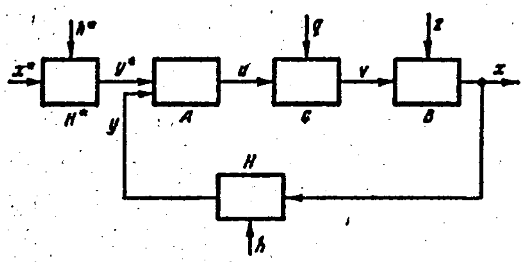

Fig.4

Card 4/4

FEL'DBAUM, A.A., prof.

Systems of automatic optimization. Zhur.VKHO 6 no.5:487-492 '61.
(MIRA 14:10)

(Automatic control)

88810

S/103/61/022/001/001/012
B019/B056

16.9500 (1132,1253,1328,1031)

AUTHOR: Fel'dbaum, A. A. (Moscow)

TITLE: Theory of Dual Control. III

PERIODICAL: Avtomatika i telemekhanika, 1961, Vol. 22, No. 1, pp. 3 - 16

TEXT: In the two earlier papers by the author, the problem of a synthesis of a system for the optimum dual control was formulated, and a general method for the solution of this problem was developed. In the present paper, the author studies the application of this method. It consists in the construction of a series of functions $\gamma_{n-k}(k = 0,1,2,..,n)$ and the finding of those values u_{n-k} of the control effect, which minimize the value of the functions γ_{n-k}. If the minimum value of γ_{n-k} corresponding to u_{n-k} is denoted by γ^*_{n-k}, the function γ_{n-k-1} is formed from γ^*_{n-k} by integration over the initial quantity y_{n-k} of the control

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object and addition of a function α_{n-k-1}. Therefore, the operations to be carried out by the dual control system correspond to the scheme shown in Fig.1 (the initial quantity y_i of the control object is in this scheme denoted by x_i). The main section of the present paper is devoted to the synthesis of the optimum control part of an automatic stabilization system. Fig. 2 shows the block diagram of such a system. Here x is the initial quantity of the control object B, A the control part of the system, u the control signal, which, together with the constant shift μ and the random noise g, is conveyed to the object B. The object B is assumed to have a linear characteristic and therefore it holds for $t = s$: $x_s = u_s + g_s + \mu$ (2). For the loss function W the following is assumed: $W = \sum_{s=0}^{u} W_s = \sum_{s=0}^{u} (x_s - x^*)^2$ (4). The main problem now consists in constructing the control part A for which the expected value of W is a minimum. In the present case, $P(x_i|\mu, u_i) = q(x_i - u_i - \mu)$ (5) holds for the probability density. For an optimum calculation it is first necessary to find the function α_k $(0 \le k \le n)$.

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Theory of Dual Control. III

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By means of complex calculation, the expression

$$u_k - x^* = w_k, \quad \sum_{i=0}^{k-1} (x_i - u_i) = \Sigma_{k-1},$$

$$\varepsilon_k = \frac{1}{2\sigma_\mu^2} + \frac{k}{2\sigma_g^2}, \quad \sum_{i=0}^{k-1} (x_i - u_i)^2 = \theta_{k-1}, \tag{16}$$

$$a_k = \frac{1}{\sqrt{2}\sigma_g^{k-2}\sigma_\mu (2\pi)^{\frac{k-1}{2}} \sqrt{\varepsilon_k}}, \quad b_k = \frac{\sqrt{\pi}}{2\sigma_g^{k-2}\sigma_\mu (2\pi)^{\frac{k+1}{2}} (\varepsilon_k)^{\frac{3}{2}}}.$$

Тогда

$$\alpha_k = \left\{a_k + b_k + \frac{2b_k}{\varepsilon_k}\left(w_k\varepsilon_k + \frac{\Sigma_{k-1}}{2\sigma_g^2}\right)^2\right\} \exp\left\{-\frac{\theta_{k-1}}{2\sigma_g^2} + \frac{\Sigma_{k-1}^2}{4\sigma_g^4\varepsilon_k}\right\}. \tag{17}$$

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Theory of Dual Control. III S/103/61/022/001/001/012
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is obtained for α_k. According to the scheme shown in Fig. 1, the minimum of the function $\gamma_n = \alpha_n$ is sought with respect to u_n with the help of (17) with k = n. In this way the author obtains

$$u_s^* = x^* - \sum_{i=0} (x_i - u_i)/(s+(\sigma_g/\sigma_\mu)^2) \quad (26), \quad (s=0,1,2,..n).$$

At the end of the first section of the present paper, the synthesis of the optimum control part A for the object B having the characteristic $x_s = \mu_2(u_s + \mu_1 + g_s)$ (28) is briefly dealt with, and, in addition, the extension of the scheme given to continuous systems is discussed. In the second section of the present paper the synthesis of the optimum control part of an automatic scanning system is dealt with. Fig. 5 shows the block scheme and the characteristics of the control object. By means of voluminous calculations, a value of α_n is again found. Fig. 7 shows the block scheme of a computer, which is able to carry out the entire

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Theory of Dual Control. III

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sequence of calculations necessary when applying the method described here. This is the block scheme of an optimum control system. As may be seen, this scheme is very complicated and requires very quick operation to be carried out by individual units. As is shown, it is therefore better to determine u_n approximately, because hitherto computers do not respond quick enough for computing such a complex process within a reasonable time. There are 8 figures and 5 references: 3 Soviet and 2 US.

SUBMITTED: April 18, 1960

Card 5/95

FEL'DBAUM, A.A. (Moskva)

Theory of dual control. Part 4. Avtom. i telem. 22 no.2:129-142 F '61. (MIRA 14:4)

(Automatic control)

FEL'DBAUM, A., prof., doktor tekhn.nauk

Automatic search. Radio no.2:11-13 F '62. (MIRA 15:1)
(Electronic control)

BERG, A.I., glav. red.; TRAPEZNIKOV, V.A., glav. red.; BERKOVICH, D.M., zaml glav. red.; LERNER, A.Ya., doktor tekhn. nauk, prof., zam. glav. red.; AVEN, O.I., red.; AGEYKIN, D.I., red.; kand. tekhn. nauk, dots., red.; AYZERMAN, M.A., red.; VENIKOV, V.A., doktor tekhn. nauk, prof., red.; VORONOV, A.A., doktor tekhn. nauk, prof., red.; GAVRILOV, M.A., doktor tekhn. nauk, prof., red.; ZERNOV, D.V., red.; IL'IN, V.A., doktor tekhn. nauk, prof., red.; KITOV, A.I., kand. tekhn. nauk, red.; KOGAN, B.YA., doktor tekhn. nauk, red.; KOSTOUSOV, A.I., red.; KRINITSKIY. N.A., kand. fiz.-mat. nauk red.; LEVIN,G.A.,prof.red.; LOZINSKIY, M.G., doktor tekhn. nauk, red.; LOSSIYEVSKIY, V.L., red.; MAKSAREV, Yu.Ye., red.; MASLOV,A.A.,dots.,red.;POPKOV,A.A.,red.; RAKOVSKIY, M.Ye., red.; ROZENBERG, L.D., doktor tekhn.nauk, prof., red.; SOTSKOV, B.S., red.; TIMOFEYEV, P.V., red.; USHAKOV, V.B., doktor tekhn. nauk, red.; FEL'DBAUM, A.A., doktor tekhn. nauk, prof., red.; FROLOV, V.S., red.; KHARKEVICH, A.A., red.; KHRAMOY, A.V., kand. tekhn. nauk, red.; TSYPKIN, Ya.Z., doktor tekhn. nauk, prof., red.; CHELYUSTKIN, A.B., kand. tekhn. nauk, red.; SHREYDER, Yu.A., kand. fiz.-mat. nauk, dots., red.; BOCHAROVA, M.D., kand. tekhn.nauk, starshiy nauchnyy red.; DELONE, N.N., inzh., nauchnyy red.; BARANOV, V.I., nauchnyy red.; PAVLOVA, T.I., tekhn. red.

(Continued on next card)

BERG, A.I.--- (continued). Card 2.

[Industrial electronics and automation of production processes]Avtomatizatsiia proizvodstva i promyshlennaia elektronika. Glav. red. A.I.Berg i V.A.Trapeznikov. Moskva, Gos.nauchn. izd-vo "Sovetskaia Entsiklopediia." Vol.1. A - I. 1962. 524 p. (MIRA 15:10)

1. Chlen-korrespondent Akademii nauk SSSR (for Sotskov, Kharkevich, Zernov, Timofeyev, Popkov).
(Automatic control) (Electronic control)

S/105/62/000/001/002/006
E140/E435

AUTHOR: Fel'dbaum, A.A. (Moscow)

TITLE: Optimization in the theory and practice of automatic control

PERIODICAL: Elektrichestvo, no.1, 1962, 39-44

TEXT: The article is a review of work (mainly the author's) in "self-optimizing" systems published previously in other journals. The central character of the problem of the design of optimal systems is stated by the author in the following terms: "This is explained by the fact that any scientifically founded system is optimal." No matter what system is adopted, "optimal criteria always exist. Otherwise the choice is unfounded". Given the criterion, the problem of constructing an optimal system is that of finding an algorithm for the system such that the criterion of quality takes on a minimal value. Two possible approaches exist in relation to the noise acting on the process: to take it into account or to neglect it. If it can be neglected an optimal system can be constructed directly. Otherwise an automatically optimized system must be constructed. The theory

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Optimization in the theory ... S/105/62/000/001/002/006
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of optimal systems is here illustrated by minimum-time systems - systems in which the return to the required coordinates occurs in minimum time after a disturbance. The problem is solved by means of the theory of isochronous surfaces in the phase space (Ref.8: Lerner A.Ya., Avtomatika i telemekhanika, v.15, no.6, 1954). Automatic optimization is investigated on the basis of the author's work on systems using a series of test steps to determine the optimization gradient, after which one "working step" is carried out in this direction. A number of machines have been built at the Inst. avtomatiki i telemekhaniki (Institute of Automation and Telemechanics) for optimization of systems of up to 12 variables (extendable easily to 144) (Ref.9: Shubin A.B., Avtomatika i telemekhanika, v.21, no.5, 1960; Ref.10: Stakhovskiy, R.I., Avtomatika i telemekhanika, v.20, no.11, 1959). These machines are used, not in the direct control of processes but in the synthesis of special-purpose optimal machines where the process appears to be simulated for the automatic optimizer. The optimization process is not always sufficiently rapid or precise. In this connection, J. Kiefer's method (Ref.13: Proc. of the American Mathematical Society, New York, v.4, no.3, 1953) is
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Optimization in the theory ... S/105/62/000/001/002/006
E140/E435

described as the most efficient for one-dimensional problems known for the worst possible case but attempts at extension of the method to several variables have so far failed. Further research efforts in automatic optimization should be devoted to broadening the classes of systems treatable by the theory and applying the theoretical results in practice (sic).
There are 7 figures and 15 references: 13 Soviet-bloc and 2 non-Soviet-bloc. The references to English language publications read as follows: Ref.7: Bellman R., On the application of the theory of dynamic programming to the study of control processes. Symposium on nonlinear circuit analysis, New York, Polytechn. Inst. of Brooklin, April 1956, p.25-27; Ref.13: as quoted in text.

SUBMITTED: July 10, 1961

Card 3/3

FEL'DBAUM, A.A.

[redacted]

"Trudy" of the Moscow Power Engineering Institute, no.44. Reviewed by A.A.Fel'dbaum. Izv. vys. ucheb. zav.; elektromekh. 5 no.12: 1432-1433 '62. (MIRA 16:6)

(Automatic control) (Remote control)

S/103/62/023/003/002/016
D201/D301

16,6800 (1250,1327,1329,2403)

AUTHORS: Bocharov, I.N., and Fel'dbaum, A.A. (Moscow)

TITLE: Automatic optimizer for the search for the least of several minima (global optimizer)

PERIODICAL: Avtomatika i telemekhanika, v. 23, no. 3, 1962, 289 - 301

TEXT: The authors consider the principles of design and describe the practical circuit of a global optimizer. This is defined as one which determines the minimum of minima (or the maximum of maxima) of the output quantity Q with the corresponding values of the input quantities $x_1, \ldots, x_n$. The search for this extremum is / may be realized in various ways, but not all of them can guarantee that the actual minimum will not be omitted. The authors suggest and describe three algorithms used for development of a model global optimizer. Algorithm No. 1 is one in which the process of search for the minimum is finished after the machine has performed μ unsuccessful trials to find the optimum value of minimum of Q, $2 \leqslant \mu \leqslant 16$.

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Automatic optimizer for the search ... D201/D301

The second algorithm is the one in which the values of Q are compared after each measurement and the new value of its minimum replaces in the memory the previous larger one. The third algorithm is such that the sign of ΔQ increment is sensed. With the reversal of sign the system goes into the normal minimum search operation. The basic parts of the global optimizer are a normal multi-channel automatic optimizer with the additional unit of global search, consisting of the extremum induction circuit (EI) and of a resetting cct (RC). The EI produces a trigger pulse, when the desired minimum is obtained; resetting circuit acts also as a limiter of integrator channel voltages. The experimental results of a model five channel global optimizer are given for the algorithm No. 1. The object was an electronic simulator with two minima and represented to parallel connected circuits for determining the moduli of inputs. The obtained recorded graph of the search process shows that the process consists of consecutive searches for both minima. The following took part in various stages of the optimizer development: R.I. Stakhovskiy, A.B. Shubin, A.V. Kalinina, V.P. Golyshev, and M.G. Stupachenko. There are 10 figures and 7 Soviet-bloc references.

SUBMITTED: August 9, 1961

Card 2/2

40132
S/103/62/023/008/001/006
D409/D301

16.4000

AUTHOR: Fel'dbaum, A.A.

TITLE: On optimal control of Markov objects

PERIODICAL: Avtomatika i telemekhanika, v. 23, no. 8, 1962, 993 - 1007

TEXT: Markov objects are defined by the author as objects, characterized by Markov processes. A basic formula is derived for the risk function. The optimal strategy is determined, proceeding from the principles of dynamic programming. The obtained formulas are illustrated by an example which shows that the optimal control device not only stores new information about the object, but also reduces the value of the obsolete information. Optimal dual control is considered, whose theory was developed by the author in earlier works. The risk function is defined by the formula

$$R = M\{W\} = M\left\{\sum_{s=0}^{s=n} W_s(s, x_s, x_s^*)\right\} = \sum_{s=0}^{s=n} M\{W_s\} = \sum_{s=0}^{s=n} R_s \qquad (4)$$

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D409/D301

16.4000

AUTHOR: Fel'dbaum, A.A.

TITLE: On optimal control of Markov objects

PERIODICAL: Avtomatika i telemekhanika, v. 23, no. 8, 1962, 993 - 1007

TEXT: Markov objects are defined by the author as objects, characterized by Markov processes. A basic formula is derived for the risk function. The optimal strategy is determined, proceeding from the principles of dynamic programming. The obtained formulas are illustrated by an example which shows that the optimal control device not only stores new information about the object, but also reduces the value of the obsolete information. Optimal dual control is considered, whose theory was developed by the author in earlier works. The risk function is defined by the formula

$$R = M\{W\} = M\left\{\sum_{s=0}^{s=n} W_s(s, x_s, x_s^*)\right\} = \sum_{s=0}^{s=n} M\{W_s\} = \sum_{s=0}^{s=n} R_s \qquad (4)$$

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where M is the mean of the loss function W; x_s denotes the output signal from the controlled object B; x_s^* - the reference signal; t=0, 1, ... , s, .., n denotes discrete moments of time. It is assumed that the control device A is characterized by a random strategy. After calculations one obtains the final formula for the risk function:

$$R_s = \int\limits_{\Omega(x_s, \vec{y}_{s-1}, \vec{u}_s, \vec{\mu}_s)} W_s(s, x_s, x_s^*)\left[\prod_{i=0}^{s}\Gamma_i\right] P(x_s \mid \mu_s, s, u_s) \times \times \left[\prod_{i=0}^{s-1} P(y_i \mid \mu_i, i, u_i)\right] P_0(\mu_0)\left[\prod_{i=0}^{s} P(\mu_i \mid \mu_{i-1})\right] d\Omega(x_s, \vec{y}_{s-1}, \vec{u}_s, \vec{\mu}_s). \quad (22)$$

where u_s is the control signal, y_s - the output signal from the feedback channel H, Ω - the domain of variation of the variables, μ - a discrete Markov process with probability density P; Γ_i is a sequence of functions (related to P). In order to determine the optimal strategy, it is necessary to choose Γ_n in such a way, so as to minimize R_n. An auxiliary function α is introduced, as well as the function

$$\gamma_{n-k} = \gamma_{n-k}(\vec{u}_{n-k}, \vec{y}_{n-k-1}) = \\ = \alpha_{n-k} + \int\limits_{\Omega(y_{n-k})} \gamma^{*}_{n-k+1}(u^{*}_{n-k+1}, \vec{u}_{n-k}, \vec{y}_{n-k})\, d\Omega(y_{n-k}) \quad (k = 0, 1, \ldots, n). \tag{34}$$

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The method of determining the optimal strategy is as follows: let u^{*}_{n-k} be the value of u_{n-k} which minimizes γ_{n-k}. Evidently

$$u^{*}_{n-k} = u^{*}_{n-k}(\vec{u}_{n-k-1}, \vec{y}_{n-k-1}), \tag{37}$$

i.e. this value depends on the values of u_i and y_i $(i=0,..,n-k-1)$, earlier observed by the control device A. Only u_0 is chosen on the basis of the apriori information exclusively. Formula (37) gives the

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D409/D301

On optimal control of ...

optimal strategy at any instant; it is a regular strategy. Two particular cases are discussed: 1) μ is a random quantity which is constant during a certain process, and 2) μ is not constant, but represents a random Markov process. An illustrative example is given. There are 3 figures. The most important English-language reference reads as follows: R. Bellman, Adaptive Control Systems. A Guided Tour. Princ. Univ. Press, 1961.

SUBMITTED: February 15, 1962

Card 4/4

FELDBAUM, A. A.

"On Theory Problems for Dual Control."

Paper to be presented at the IFAC Congress held in Basel, Switzerland, 27 Aug to 4 Sep 63

ACCESSION NR: AT3001884 S/2906/62/000/000/0186/0198

AUTHOR: Fel'dbaum, A. A.

TITLE: Automatic synthesis of optimal automatic control systems

SOURCE: Kombinirovannyye vychislitel'nyye mashiny; trudy II Vsesoyuznoy konferentsii-seminara po teorii i metodam matematicheskogo modelirovaniya, Moscow, Izd-vo AN SSSR, 1962, 186-198

TOPIC TAGS: computer, control system, automatic, optimal, optimization, synthesis, design, variation, variational, calculus

ABSTRACT: This theoretical paper endeavors to derive general laws on what can and what cannot be obtained in the search for optimal automatic control systems under specified real conditions. The problem of the synthesis of an optimal control system reduces ultimately to the development of a control system that produces the best possible (in a certain sense) process in a system comprising a given control object. The problem is stated in mathematical terms, and it is concluded that in many complicated problems it is impossible to find the optimal-control algorithm in the form of an equation. Both the Pontryagin extremal principle and the method of dynamic programming can be of some assistance only in determining the

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organization of the calculations that may serve to solve the problem of the determination of optimal control by means of the computer. These calculations are difficult and, at times, even impossible on existing computing equipment. Inasmuch as the search is not for a rigorously optimal solution, but one that is close to it, an approximate search may be satisfied by the automatic searching equipment for the algorithm of an optimal control equipment developed at the Institut avtomatiki i telemekhaniki AN SSSR (Institute of Automation and Telemechanics, AS USSR) which is of a hybrid character: The control block consists of discrete-logic elements, while the other parts of the equipment consist of continuously-acting elements. Result: Ability to take into account the complicated search algorithms, combined with the simplicity and speed characteristic of continuous-action equipment. Speed is essential for a rapid scanning of a multiplicity of different versions. The complex of automatic-synthesis equipment consisting of an assembly of individual blocks is described. The method of automatic synthesis thus described is applicable in those instances in which there is no theory that would afford a reasoning for the construction of an algorithm for the equipment controlled. However, when theory provides at least some supplementary information, not on the class of algorithms from which an optimal algorithm may be selected, but on the method whereby one may construct an optimal algorithm, then a so-called rationalized method for the search for an optimal algorithm becomes possible. The author recently

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set forth the concept of applying the latest variational methods as methods for the rationalization of the search during automatic synthesis (1959, 1960). In fact, the extremal principle and the method of dynamic programming can be regarded as methods of the rationalization of the automatic search. The "empirical" method described above requires a search for a minimum of a function of a great number of variables in any complicated system. By contrast, the variational methods permit the replacement of the search of a minimum of a function of a great number of variables with a succession of operations, including operations of minimization of a few functions which have a small number of variables and, at times, only a single variable. This is explained using the Pontryagin extremal principle. The automatic search is then reduced to a "fast" stage and a "slow" stage and, if the object is linear, then the integration of the "fast" search can be replaced by the integration of a special system of equations, and only the "slow" process of automatic search remains to be done (per Pontryagin et al., 1961). A breadboard-model investigation of this process of optimization has been performed at the IAT AN SSSR. A block diagram of the arrangement tested is shown, and some of the difficulties encountered in the experimentation are identified. The basic difficulty consists in the large volume of multi-variable functions to be memorized; this requires an exceedingly large memory capacity. Therefore, it is necessary to replace the functions to be remembered by a much smaller number of parameters

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characterizing the functions. The combination of some form of automatic-search method with variational methods appears to be one of the potentially most productive paths toward the expansion of the range of applicability of automatic synthesis. Orig. art. contains 6 figures and 23 numbered equations.

ASSOCIATION: none

SUBMITTED: 00 DATE ACQ: 11Apr63 ENCL: 00

SUB CODE: CP, MM NO REF SOV: 015 OTHER: 000

Card 4/4

AM4037189 BOOK EXPLOITATION S/

Fel'dbaum, Aleksandr Aronovich

Principles in the theory of optimal control systems (Osnovy* teorii optimal'ny*kh avtomaticheskikh sistem), Moscow, Fizmatgiz, 1963, 552 p. illus., biblio., index. 7,000 copies printed.

TOPIC TAGS: automation, computer engineering, optimal control system

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Ch. III. Optimal systems with complete information about the controlled object -151
Ch. IV. Optimal systems with maximum incomplete information about the controlled object -- 247
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SUB CODE: EC, DP

SUBMITTED: 24Oct63

NR REF SOV: 127

OTHER: 115

DATE ACQ: 16Apr64

Card 2/2

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a number of ...
... greater or require greater ...
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... of regular signals by systems ...

... their characteristics ...
... for the transformation of signals ...
... linear systems ...
... systems ...
Nonlinear and parametric systems — — 410
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... of random signals by systems
... transformation of random signals by linear ...
... of random signals by nonlinear systems ...

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Ch. I. Elements of information theory - - 746
Ch. II. Elements of the theory of statistical solutions - - 840

SUB CODE: DP, EC SUBMITTED: 31Oct63 NR REF SOV: 073

OTHER: 009

Card 3/3

S/280/63/000/001/001/016
E140/E435

AUTHOR: Fel'dbaum, A.A. (Moscow)

TITLE: Application of statistical decision theory to open- and closed-loop automatic control systems

PERIODICAL: Akademiya nauk SSSR. Izvestiya. Otdeleniye tekhnicheskikh nauk. Tekhnicheskaya kibernetika. no.1, 1963, 13-25

TEXT: The author has been studying the applications of statistical decision theory to servomechanisms and control systems, similar to the work of J.G.Truxal and J.J.Padalino (Ref.8: Decision theory - Ch.15 of the book "Adaptive Control systems" Ed. by E.Mishkin, L.Braun. McGraw-Hill Book Comp. 1961) and J.C.Hsu, W.E.Meserve (Ref.9: Decision - Making in Adaptive Control Systems. IRE Trans. on Automatic Control, January 1962). The present note concerns the comparison of the principal aspects of the theory as applied to open-loop systems and to closed-loop systems. The concept of reducible system is introduced, i.e. a closed-loop system for which an equivalent open-loop system exists. In the first part systems in which the controlled process is without lag are studied.
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The systems of Fig.1 and 2 are compared, where A is the control, B the process and H, E channels to which all the system noise is ascribed. The systems are evaluated on the basis of minimizing the mean risk. It is shown that the behavior of system of Fig.2 is more complex than that of Fig.1, since the control action u_s has a dual character; in addition to the control action proper, it permits the accumulation of information on the process characteristics, which may be initially unknown or poorly known. The problem of optimal control in such a system must take into account the dual character of the control and can be approached by the method of dynamic programming. The optimal strategy is found to be regular. When such systems are reduced to the equivalent open-loop form, the calculations are found to be substantially simplified. This is the reason, according to the author, that in Ref.8 and 9, the calculations are found to be "exceedingly simple". It was shown by the present author (Avtomatika i telemekhanika, v.21, no.9, 1960; v.22, no.1,2, 1961) that in closed-loop systems in general the optimal strategy depends on the accumulation of information about the process; there exist however "neutral" systems in which this accumulation is independent of the control signal. This is precisely the case for reducible systems (those studied in Ref.8 and 9). In the second part of the paper the author extends his results to systems with lag. The conclusion of the paper states that feedback systems are essentially richer than open systems, having characteristics that no open-loop system can have. There are 3 figures.

SUBMITTED: October 10, 1962

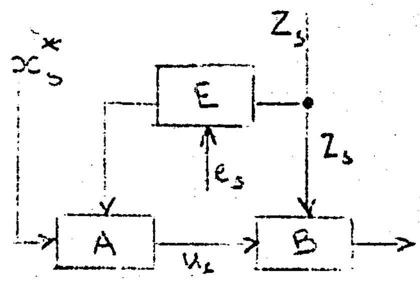

Fig.1.

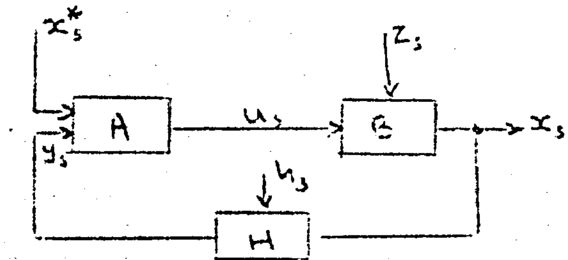

Fig.2.

MOTSKUS, M.B.; FEL'DBAUM, A.A.

Symposium on multioptimalizing problems. Izv. AN SSSR. Tekh. kib. no.5:175-176 S-O '63. (MIRA 16:12)

MOTSKUS, I.B.; FEL'DBAUM, A.A.

Symposium on multiextremal problems. Avtom. i telem. 24 no.11: 1597-1598 N '63. (MIRA 16:12)

FELDBAUM, A.A., a muszaki tudomanyok doktora (Moscow)

Problems of image recognition. Pt.2. Meres automat 12 no.12:376-379 '64.

BERG,A.I.,glav.red.; TRAPEZNIKOV,V.A.,glav.red.; TSYPKIN, Ya.Z., doktor tekhn.nauk,prof.,red.; VORONOV,A.A., doktor tekhn.nauk,prof.,red.; SOTSKOV,B.S., doktor tekhn.nauk,red.; AGEYKIN,D.I., doktor tekhn. nauk, red.; GAVRILOV,M.A., red.; VENIKOV,V.A., doktor tekhn.nauk, prof.,red.; CHELYUSTKIN,A.B., doktor tekhn. nauk,red.; PROKOF'YEV, V.N., doktor tekhn.nauk,prof.,red.; IL'IN,V.A., doktor tekhn.nauk, prof.,red.; KITOV,A.I.,doktor tekhn.nauk,red.; KRINITSKIY, N.A., kand. fiz.-matem.nauk,red.; KOGAN,B.Ya., doktor tekhn.nauk, red.; USHAKOV,V.B., doktor tekhn.nauk,red.; LERNER,Yu.A., doktor tekhn. nauk,prof., red.; FEL'DBAUM, A.A.,prof., doktor tekhn.nauk,red.; SHREYDER,Yu.A., kand. fiz.-mat. nauk,dots.,red.; KHARKEVICH,A.A., akad., red.;TIMOFEYEV,P.V., red.; MASLOV,A.A.,dots.,red.; LEVIN, G.A., prof.,red.; LOZINSKIY,M.G., doktor tekhn.nauk,red.; NETUSHIL, A.V., doktor tekhn.nauk,prof.,red.; POPKOV,V.I.,red.; ROZENBERG, L.D.,doktor tekhn.nauk,prof.,red.; LIVSHITS,A.L.,kand.tekhn.nauk,red.

[Automation of production and industrial electronics] Avtomatizatsiia proizvodstva i promyshlennaia elektronika; entsiklopediia sovremennoi tekhniki. Moskva, Sovetskaia Entsiklopediia. Vol.3. Pogreshnost' resheniia - Teleizmeritel'naia sistema chastotnaia. 1964. 487 p. (MIRA 17:10)

1. Chlen-korrespondent AN SSSR (for Sotskov, Gavrilov, Timofeyev, Popkov).

ACCESSION NR: AP4035068 S/0103/64/025/004/0433/0444

AUTHOR: Fel'dbaum, A. A. (Moscow)

TITLE: One class of self-learning systems with dual control

SOURCE: Avtomatika i telemekhanika, v. 25, no. 4, 1964, 433-444

TOPIC TAGS: automatic control, self learning automatic control, duel self learning automatic control, closed loop automatic control, optimum self learning

ABSTRACT: A self-learning automatic-control system of the class shown in Fig. 1 of the Enclosure is theoretically considered. Block A includes two subblocks A_1 and A_2; A_1 is the principal controller of the system; A_2 comprises equipment intended for improving the algorithm of A_1 so that the system A_1 - B approaches optimum. Signal u_s goes to plant B via an inertialess channel G having a random noise g_s. The law linking the output v_s with the inputs u_s and g_s is known. The output x_s of plant B goes to the controller via an inertialess channel H with a noise h_s. The channel output y_s is a known function of x_s and h_s. A known variable x^*_s is applied directly to A. Based on these premises, the principal

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ACCESSION NR: AP4035068

formulas for dual control are developed, and an optimum strategy is determined. An elementary example illustrates the theoretical findings. Orig. art. has: 5 figures and 57 formulas.

ASSOCIATION: none

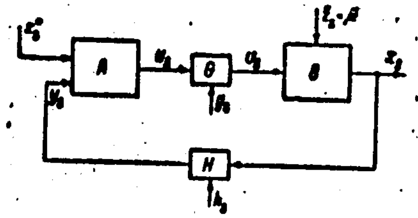
SUBMITTED: 27Jun63 ENCL: 01 SUB CODE: DP, IE

NO REF SOV: 005 OTHER: 007

Card 2/3

ACCESSION NR: AP4035068

ENCLOSURE: 01



Functional diagram of a dual-control self-learning automatic system

The subscripts identifies the variables at some discrete moment of time

Card 3/3

APPROVED FOR RELEASE: Monday, July 31, 2000 CIA-RDP86-00513R000412820(

... frequency transfer function are ...

KOGAN, B.Ya., doktor tekhn. nauk, otv. red.; KOTEL'NIKOV, V.A., kand. tekhn. nauk, red.; FEL'DBAUM, A.A., doktor tekhn. nauk, red.; KHRAMOY, A.V., kand. tekhn. nauk [deceased]; TSYPKIN, Ya.Z., doktor tekhn. nauk, red.; SHILEYKO, A.V., kand. tekhn. nauk, red.

[Computer technology in control; collection of the transactions] Vychislitel'naia tekhnika v upravlenii; sbornik trudov. Moskva, Nauka, 1964. 221 p. (MIRA 17:12)

1. Vsesoyuznaya konferentsiya seminara po teorii i metodam matematicheskogo modelirovaniya. 3d, 1962.

Baum, A. A.

learning process in humans and automatons

Kibernetika, myshleniye, zhizn' (Cybernetics ...) Moscow, 1964, 421-458

learning process, learning theory ... automaton learning ...

SR AT5008647

none

FELDBAUM, A.A., prof. (Moscow)

Problems of image recognition. Meres automat 12 no.11:347-350 '64.

BERG, A.I., glav. red.; TRAPEZNIKOV, V.A., glav. red.; TSYPKIN, Ya.Z., doktor tekhn. nauk, prof., red.; VORONOV A.A., prof., red.; AGEYKIN, D.I., doktor tekhn.nauk red.;GAVRILOV, M.A., red.; VENIKOV, V.A., doktor tekhn. nauk, prof., red.; SOTSKOV, B.S., red.; CHELYUSTKIN, A.B., doktor tekhn. nauk, red.; PROKOF'YEV, V.N., doktor tekhn. nauk, prof., red.; IL'IN, V.A., doktor tekhn. nauk, prof., red.; KITOV, A.I., doktor tekhn. nauk, red.; KRINITSKIY, N.A., kand. fiz. mat. nauk, red.; KOGAN, B.Ya., doktor tekhn. nauk, red.; USHAKOV, V.B., doktor tekhn. nauk, red.; LERNER, A.Ya., doktor tekhn. nauk, prof., red.; FEL'DBAUM, A.A., doktor tekhn. nauk, prof., red.; SHREYDER, Yu.A., kand. fiz.-mat. nauk, red.; KHARKEVICH, A.A., akademik, red. [deceased]; TIMOFEYEV, P.V., red.; MASLOV, A.A., dots., red.; TRUTKO, A.F., inzh., red.; LEVIN, G.A., prof., red.; LOZINSKIY, M.G., doktor tekhn. nauk, red.; NETUSHIL, A.V., doktor tekhn. nauk, prof., red.; POPKOV, V.I., red.; ROZENBERG, L.D., doktor tekhn. nauk, prof., red.; LIFSHITS, A.L., kand. tekhn. nauk, red.; AVEN, O.I., kand. tekhn. nauk, red.; BLANN, O.M.[Blunn, O.M.], red.; BROYDA, V., inzh.,prof.,red.; BREKKL', L [Brockl,L.] inzh., knad. nauk, red.; VAYKHARDT, Kh. [Weichardt, H.], inzh., red.; BOCHAROVA,M.D., kand. tekhn. nauk, st. nauchn. red.

[Automation of production processes and industrial electronics] Avtomatizatsiia proizvodstva i promyshlennaia elektronika; entsiklopediia sovremennoi tekhniki. Moskva, Sovetskaia entsiklopediia. Vol.4. 1965. 543 p. (MIRA 18:6)

MEYEROV, Mikhail Vladimirovich; FEL'DBAUM, A.A., prof., retsenzent;
FURMANOV, D.S., red.

[Systems of multiple-coupled control] Sistemy mnogosviaz-
nogo regulirovaniia. Moskva, Nauka, 1965. 384 p.
(MIRA 18:9)

KHRAMOY, A.V. [deceased]; MEYEROV, M.V.; AYZERMAN, M.A.; ULANOV, G.M.; TSYPKIN, Ya.Z.; FEL'DBAUM, A.A.; LERNER, A.Ya.; PUGACHEV, V.S.; IL'IN, V.A.; GAVRILOV, M.A.

Work of the Institute of Automatic and Remote Control on the development of the theory of automatic control during 1939-1964. Avtom. i telem. 25 no. 6:763-807 Je '64.
(MIRA 17:7)

L 04774-67 EWT(d)/EWP(v)/EWP(k)/EWP(h)/EWP(1) GD

ACC NR: AT6016440 (A) SOURCE CODE: UR/0000/65/000/000/0300/0316

AUTHOR: Fel'dbaum, A. A.

33
B+1

ORG: none

TITLE: On problems in the theory of dual control

SOURCE: International Federation of Automatic Control. International Congress. 2d, Basel, 1963. Diskretnyye i samonastraivayushchiyesya sistemy (Discrete and adaptive systems); trudy kongressa. Moscow, Izd-vo Nauka, 1965, 300-316

TOPIC TAGS: optimal automatic control, circuit design, automatic control theory

14

ABSTRACT: The control device in an automatic system solves two problems which are closely connected, but differ in nature: (1) from the incoming information it ascertains the properties and state of the controlled plant (studies the plant); (2) from the plant properties it determines what actions must be taken for successful control (bringing the plant into the needed regime). In complex cases the control device must solve both problems. This paper examines the problems of designing an optimum device which simultaneously solves both problems. The author states the problem, derives the basic formula, and determines optimum strategy. The

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L 04994-67

ACC NR: AT6016440

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theory of dual control may be extended in different direction, e.g., to purely discrete systems in which each of the magnitudes may take only one of the permitted levels. Development of this theory will elucidate the principles of optimum teaching of discrete automatons. The theory discussed is of the Bayes type since it assumes that a priori probability characteristics are known, but it is advisable to construct a theory of dual control also for cases where these characteristics are unknown. This must be done either on the minimax principle or by adducing the idea of inductive probability. At present the most important next problem is to develop approximate methods of solving dual control theory problems and suboptimum strategies and to solve the ensuing problems. Orig. art. has: 71 formulas and 5 figures.

SUB CODE: 09/ 13/ SUBM DATE: 29Sep65/ ORIG REF: 007/ OTH REF: 005

Card 2/2

L 05286-67 EWT(d)/EWP(1) IJP(c) BB/GG/GD

ACC NR: AT6022675 SOURCE CODE: UR/0000/66/000/000/0073/0080

AUTHOR: Fel'dbaum, A. A. (Doctor of technical sciences) 43

ORG: none 8+1

TITLE: Certain principles of pattern recognition 16

SOURCE: Moscow. Institut avtomatiki i telemekhaniki. Samoobuchayushchiyesya avtomaticheskiye sistemy (Self-instructing automatic systems). Moscow, Izd-vo Nauka, 1966, 73-80

TOPIC TAGS: pattern recognition, automaton, automatic machine teaching, dynamic system

ABSTRACT: In most existing systems instructed to recognize patterns, recognition is an instantaneous act performed by a certain logic process. Therefore, such instructed systems can be called static. However, when working out recognition systems there is another approach which is not without promise. This approach lies in constructing dynamic instructing recognition systems in which recognition is not an instantaneous act, but some process. The important prospects opened by this approach are explained by the following considerations. 1. Any picture or image represents not a simple totality of its elements but an ordered totality. The relationship of a picture to a specific class depends not only on the color or brightness of its

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ACC NR: AT6022675 O

elements but also on their relationship to one another. In this article only visual images are examined and therefore the article deals only with spatial relationships. However, in a more general formulation of the problems the elements of an image can be related with one another by such relationships as time, causal, etc. An analysis of the mutual arrangement of elements and parts of an image acquires an extremely cumbersome form with the simultaneous delivery of information concerning all elements of the image to a logic system. Furthermore, it is precisely this principle that is used in static systems of recognition. This analysis is extremely simplified by successive transition from some parts to others which is accomplished in the dynamic instructing systems of recognition by scanning the spatial picture and converting it into a time sequence. 2. Recognition of images by man or by an animal is a process encompassing an entire complex of links of the visual or tactile organs of sense. Apparently the processes of recognition are related in these types of sense organs. In tactile recognition there is a shift from one section of the image to another. A similar process takes place in the visual organ of sense where, as a result of the movement of the eyeball the elements of the picture are projected in a definite sequence onto the most sensitive part of the retina, the macula lutea. Thus, the characteristic feature of the work of the sense organ is a form of scanning the elements of the picture and the character of scanning is not rigidly predetermined but depends upon observations made during the recognition process. This mechanism of internal feedback imparts appreciable flexibility to the apparatus of the sense organ. The task of

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ACC NR: AT6022675

the investigation which served as the basis for this article did not include an attempt to simulate the processes of recognition occurring in a living organism, but certain concepts of these processes can prove to be beneficial when developing new types of automatons, in particular dynamic instructing systems of recognition. The dynamic process of recognition, by simplifying the analysis of relations between elements of an image will apparently create the feasibility of recognizing complex images, which static systems of recognition still cannot do. At present only preliminary experimental data have been obtained with regard to checking out the performance of the principles discussed, and much remains to be done to further develop and improve the dynamic instructing systems of recognition. However, the development of the principles of devices employing dynamic instructing systems of recognition will promote the construction of instructing automatons. Orig. art. has: 6 figures.

SUB CODE: 05, ~~06~~, 09/ SUBM DATE: 02Mar66/ ORIG REF: 009/ OTH REF: 001

Card 3/3 egh

MIROSHNICHENKO, F.D.; FEL'DBLYUM, I.S.

Methods for improvement of the magnetic parameters and temperature stability of ferrate rings made from "Oksifer-2000" material. Izv. vys.ucheb.zav.;fiz.no.2:167-171 '63.

(MIRA 16:5)

1. Zaporozhskiy gosudarstvennyy pedagogicheskiy institut.
(Ferrates--Magnetic properties)
(Ferrate--Thermal properties)

FEL'DBAUM, O.A.; KUNTSEVICH, V.M.; KOSTYUK, V.I.;
MANDROVSKIY-SOKOLOV, B. Yu. [Mandrovs'kyi-Sokolov, B. IU.]
VAN-NAYS, R. [Van Nyce, R. I.] (SShA)

Concerning the optimum value of the trial steps of extremum systems.
Avtomatyka no.2:94-97 '61. (MIRA 14:6)
(Automatic control)

FEL'DBAUM, O.A., prof.

Concerning the optimum value of the trial steps of optimalizing systems. Avtomatyka no.5:92-93 '61. (MIRA 14:10)
(Automatic control)

FEL'DBAUM, S.

World tonnage of chartered dry cargo ships in 1964. Mor. flot 25 no.4:43-44 Ap '65. (MIRA 18:6)

1 Nachal'nik Kon"yunkturnogo otdela Vsesoyuznogo ob"yedineniya "Sovfrakht".

FEL'DBAUM, S.

World tonnage of chartered dry-cargo carriers in 1963.
Mor. flot. 24 no.5:42-43 My '64. (MIRA 18:12)

1. Nachal'nik kon"yunkturnogo otdela Sovfrakhta.

POKIDKO, Nikolay Maksimovich; FAFURIN, Nikolay Andreyevich; FEL'DBAUM, S.S., redaktor; SEMENOVA, M.M., redaktor; TIKHONOVA, Ye.A., tekhnicheskiy redaktor.

[Transporting lumber by sea] Perevozka lesa morem. Moskva, Izd-vo "Morskoi transport", 1956. 69 p. (MLRA 9:5)
(Lumber--Transportation)

GUBERMAN, Roman L'vovich, kand. ekon. nauk; MARKELOV, Petr Alekseyevich; FEL'DBAUM, Samson Solomonovich; SHERESHEVSKIY, Leonid Emmanuilovich; KEYLIN, A.D., prof., red.; LEVCHUK, K.V., red. izd-va; TSAGURIYA, G.M., tekhn. red.

[Transportation organization of export and import freight in the U.S.S.R.] Organizatsiia perevozok eksportnykh i importnykh gruzov SSSR. [By] R.L.Guberman i dr. Moskva, Vneshtorgizdat, 1962. 250 p. (MIRA 16:5)

(Freight and freightage)

FEL'DBERG, K. A. Cand Agr Sci -- (diss) "Selection of table varieties of grapes for the Donbas, and the effect of the pruning of bushes upon ~~the~~ Commercial ~~marketing~~ qualities of table grapes." Mos, 1959. 20 pp (Mos Order of Lenin Agr Acad im K. A. Timiryazev), 110 copies (KL, 52-59, 124)

FEL'DBERG, Klavdiya Antonovna; MASLOBOYSHCHIKOVA, A.S., red.; POTOTSKAYA, L.A., tekhn. red.

[Table grape varieties in the Donets Basin]Stolovye sorta vinograda v Donbasse. Kiev, Gossel'khozizdat USSR, 1962. 151 p. (MIRA 15:11)

(Donets Basin--Grapes--Varieties)

FEL'DHEYN, B.

Losses have been completely eliminated. Mias. ind. SSSR 29 no.6:40 '58. (MIRA 11:12)

1.Krymskiy myasotrest.
(Crimea--Meat industry)